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# 11 Guardrail

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## W-Beam Guardrail

*Pre-Installation*

*Inspection During Installation*

*Basis for Use*

## Modified Guardrail

## End Treatments and Transitions

## Footings and Anchors

## Impact Attenuators

## Measurement and Payment

# ***CHAPTER ELEVEN***

## ***GUARDRAIL***

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The purpose of placing guardrail is to reduce the severity of potential accidents caused by an errant vehicle leaving the roadway down a steep embankment. Because guardrail is also a hazard, the guardrail should only be installed if the installation offers less potential hazard than the obstacle or embankment slope. The design of the contract should eliminate a number of the factors that warrant the installation of guardrail.

The technician is required to ensure the guardrail is placed according to the requirements set forth in the plans and Specifications and to keep accurate accounts of all guardrail that is placed.

Due to ever changing research and development associated with guardrail, the most current Standards and Specifications should be consulted prior to the construction of any guardrail.

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### **W-BEAM GUARDRAIL**

W-beam guardrail (Figure 11-1) elements are required to be steel and be in accordance with the applicable requirements for steel beam guardrail as shown in the Specifications and on Standard Sheets **601-WBGA-01, & 03, 601-WBGC-01, 02, & 03, 601-CWGS-06, and 601-RHPG-03**. Aluminum tubular, rub-railing, and steel block-outs are not used on new contracts, and all information in the Specifications and Standards is used for maintenance contracts for existing installations only.

The components, assembly, post spacing, post lengths, and installation for each location is shown on the plans. Double-facing of the guardrail is required at the locations also shown on the plans. In locations that do not allow for the standard 7 ft posts, 6 ft posts may be substituted when approved.



**Figure 11-1. W-Beam Guardrail**

***PRE-INSTALLATION***

Prior to the inspection of guardrail placement the technician is required to review all of the following information:

- 1) The General Notes section of the plans may specify a type of railing, end section, and post spacing.
- 2) The Detail Sheets section of the plans indicate the specific location, length, and type of rail required, along with the locations and type of end treatment.
- 3) Specifications provide a description of the work, materials used, general requirements, the method of measurement and basis of payment. The latest manufacturers manual should also be checked.
- 4) Shop drawings are sent to INDOT for review and approval.
- 5) The General Instructions to Field Employees provides helpful ideas concerning the guardrail procedures.

Before guardrail is placed, the technician is required to verify that the correct type and quantity of guardrail is specified and that the basis of use requirements are met.

#### ***INSPECTION DURING INSTALLATION***

The technician is required to carefully inspect the Contractor's work to ensure proper placement. The following items are checked:

- 1) The slope of shoulder from the edge of the pavement to the face of the guardrail is required to be the same as that of the planned shoulder slope, with a distance between the two of no more than 2 ft . (Standard Sheet **601-WBGA-01.**)
- 2) The guardrail is required to be placed at a height of 2 ft 3 in., measured along the front face of the rail.
- 3) The front face of the rail is required to be the correct distance specified in the plans from the edge of the pavement. Except for flares and tapers at the end of the railing, the shoulder is required to be paved up to the front face of the railing.
- 4) The rail is required to be built as parallel to the ground as possible; however, the rail is required to be adjusted vertically to maintain a uniform appearance.
- 5) Metal posts are required to be driven. If conditions do not allow driving the posts, then at least a 12 in. diameter hole is required to be drilled and backfilled with soil in 6 in. lifts after which the post is then driven.
- 6) Rail Elements are required to be lapped in the direction of the closest traffic. For example, roofing shingles are lapped in the direction of the flow of water down the roof.
- 7) When new guardrail is being installed to replace existing guardrail and traffic is to be maintained during the work, the installation of the new guardrail follows the removal of the existing guardrail as closely as practical. Adequate safety protection is required to be provided as directed between the time that the existing guardrail is removed and the time that the installation of the new guardrail is complete.
- 8) When new guardrail is being installed where there is no existing guardrail and traffic is to be maintained during the

work, the time between the installation of the posts and the mounting of the blocks and rail elements may not exceed 24 h. Drums are required to be placed to mark all installed guardrail posts left bare overnight.

- 9) Blocks and rail elements are required to be erected in a manner resulting in a smooth, continuous installation.
- 10) Elements which are cut or drilled are coated with a high zinc dust-zinc oxide paint in accordance with the Specifications.
- 11) Expansion joint openings in guardrail, where connected to the bridge rail, are required to be 1 in. plus the deck expansion joint installation opening.
- 12) All bolts are required to be tightened.

#### ***BASIS FOR USE***

The basis for use requirements and acceptance of steel beam guardrail is as follows:

- 1) Installer on a certification basis with random in-place testing of guardrail on a yearly basis: The installer is assigned a 6 digit "Q" number which is the basis of use for the Material Record.
- 2) Installer not on a certification basis: Materials are sampled at the job-site after delivery with no materials being used until they are tested and approved. The laboratory number is the basis of use for the Material Record.

#### **MODIFIED GUARDRAIL**

Modified guardrail is regular railing with adjustments such as longer or shorter posts, different post spacing, nesting of the railing, or the use of double faced railing. When a pay item of modified guardrail is included in the contract, the Specifications should be checked. An example of an area requiring modified guardrail would be at supports for overhead sign structures. Placement is required to be as shown on Standard Sheet **601-RHPG-03**.

When existing guardrail no longer meets the 2 ft 3 in. minimum height requirement, usually due to the addition of resurface material, one of the following items is specified:

- 1) “Adjust Guardrail Height, Adjustable Post Bracket” is used when the use of existing adjustable post brackets allows the existing railing to be raised to the required 2 ft 3 in.
- 2) “Adjust Guardrail Height” is used when replacement of existing post brackets with adjustable post brackets is required to raise the existing railing to the required 27 in.
- 3) “Reset Guardrail” is used when the addition of adjustable post brackets does not raise the existing railing to the required 27 in. height. Reset guardrail is set with a 30 in. rail height and consists of the careful removal of existing guardrail, possible storing, and then erecting where shown on plans or as directed. This work also includes the replacement of damaged or missing parts and new posts as directed.
- 4) Complete replacement of the guardrail may be another option, if the guardrail is not up-to-date and the cost is comparable to resetting.

## **END TREATMENTS AND TRANSITIONS**

The end of the guardrail which faces approaching traffic is required to have some type of end treatment to decrease the chances of vehicle impalement. The SKT 350, ET-2000, and ET-Plus are the most common end treatments used. Other end treatments such as the C-A-T are more complicated and expensive. The technician is required to have a complete set of shop drawings if the item is not clearly shown on the Standard Sheets. Incorrectly following the shop drawings may cause serious injury to a motorist hitting the end treatment. For example, placing washers in the correct place is critical to the end treatment because the end treatment will not function properly without the washers. The technician is required to also verify that the required shoulder slopes and rail flares are placed in the vicinity of the end treatment.

End treatments (Figure 11-1) may be detailed on the plans as is the case for Type I and II sections, or may be selected from an approved list which includes OS, MS, and Type I end treatments. The plans include reflectorization and grading requirements for each of the end treatments. Each unit is required to be installed in accordance with the manufacturer’s recommendations and within 24 h of completion of the guardrail.



**Figure 11-1. Guardrail End Treatment**

Assembly and installation of end treatments is required to be supervised or conducted at all times by an installer trained and certified by the unit's manufacturer. A copy of the installer's certificate is required to be provided to the PE/PS prior to the start of work. Basis for use for all guardrail end treatments is a six digit "W" number, which represents the manufacturer of the specified treatment.

When installing end treatments to existing rub-rail type guardrail, the rub-rail, if not spliced at the last existing post, is cut and the end repositioned behind the flange of the post (Standard Sheet **601-TTVH-01**).

Guardrail transitions are required to connect the guardrail to the bridge rail, and the guardrail to piers (Standard Sheet **601-TTGB-01**).

Guardrail buried end sections are considered a Type II end treatment and are rarely used.

## **FOOTINGS AND ANCHORS**

Some modified guardrail sections will require concrete either as concrete footings or as anchors. The recommended inspection is required to be as follows:

- 1) Inspect the excavation for the required dimensions.
- 2) Inspect the proposed finished concrete grade. The air content, yield, and slump are required to be check as required by the Frequency Manual.

- 3) Verify that the excavation is reasonably dry.
- 4) Verify the posts are plumb and to the required grade.
- 5) Verify that the concrete anchors have the proper attachments set into the concrete at the proper position, along with any specified reinforcements.
- 6) Verify that the proper curing of the concrete is done.

## **IMPACT ATTENUATORS**

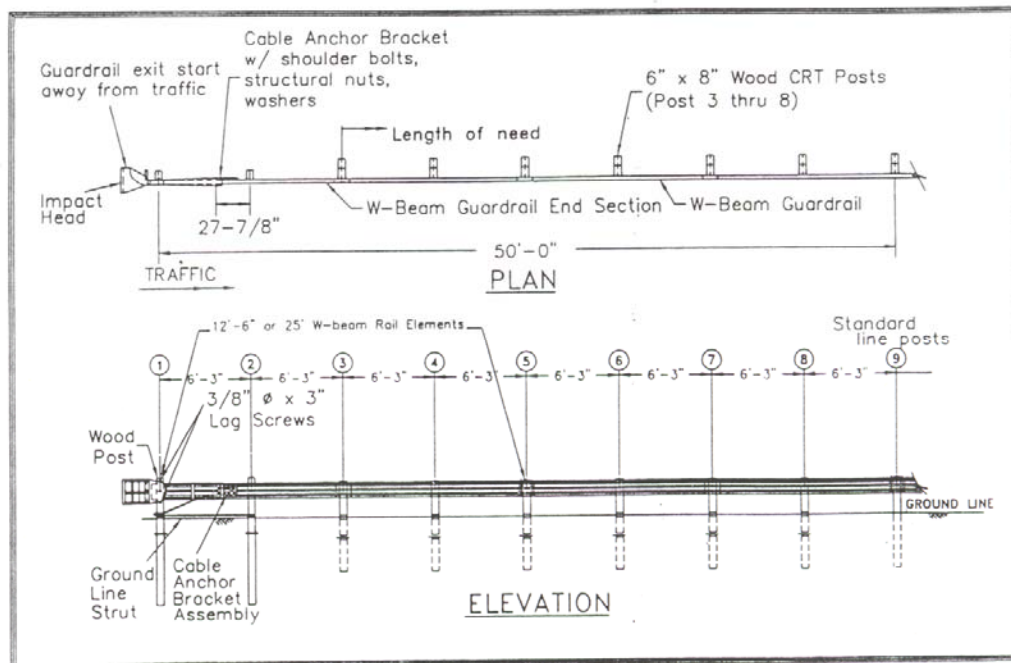
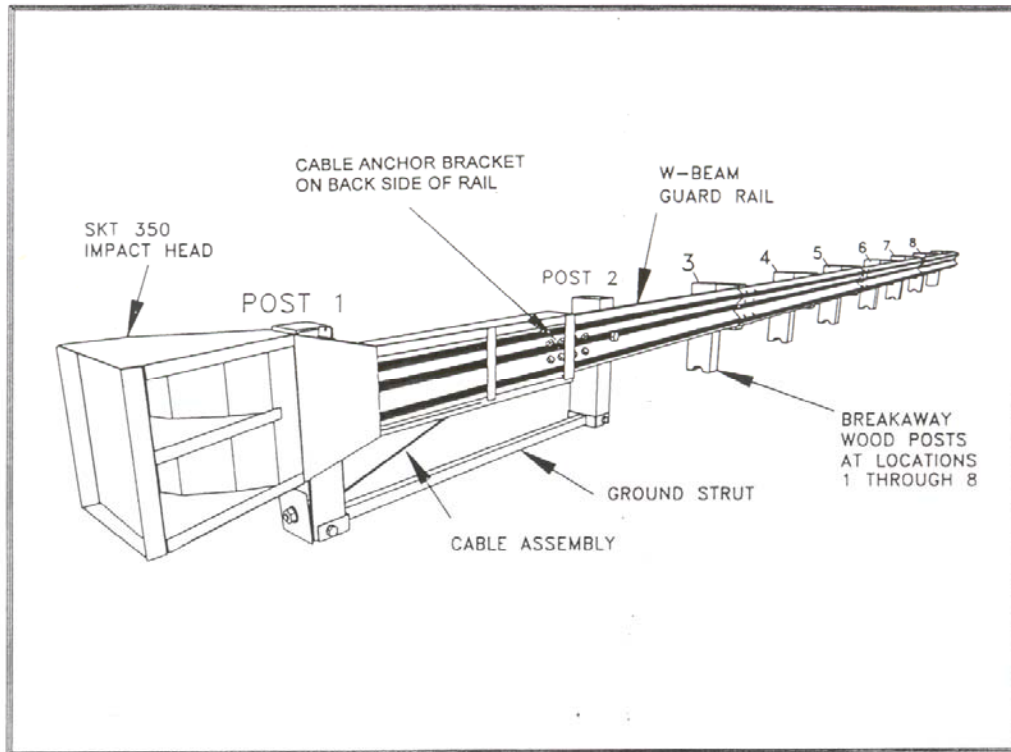
Impact Attenuators are used as crash cushions in high speed environments on the face of blunt objects located within the clear zone. They are very similar to end treatments, but are designed to prevent vehicles from coming into contact with hazards at speeds of up to 70 mph. Notable locations of use would be bridge piers, overhead signs, and other such objects that pose a hazard to the traveling public. G-R-E-A-T (Guardrail Energy-Absorbing Terminal), Sentre, REACT 350, and QuadGuard are examples of Impact Attenuators that are used (Figures 11-2 to 11-5)

Impact Attenuators are required to be selected from those included on the INDOT list of approved Impact Attenuators. Each unit is required to be placed in accordance with the manufacturer's recommendations on a concrete pad. The installation is supervised or conducted at all times by an installer trained and certified by the unit's manufacturer. A copy of the installer's certificate is required to be provided to the PE/PS prior to the start of work.

## **MEASUREMENT AND PAYMENT**

Measurement of guardrail is done by the linear foot along the top of the rail. End treatments, transitions, and attenuators are excluded from the measurement because they are paid as a lump sum for each. All items are required to be measured and documented for payment on a daily basis. These measurements are required to be accurate enough for final payment so that additional measurements are not required at a later date. The cost of reflectorization, grading, earthwork, concrete pad, excavation, concrete footings, reinforcement, and structural steel tubing for modified posts is included in the cost of the perspective pay items.





**Figure 11-2. SKT 350 End Treatment**

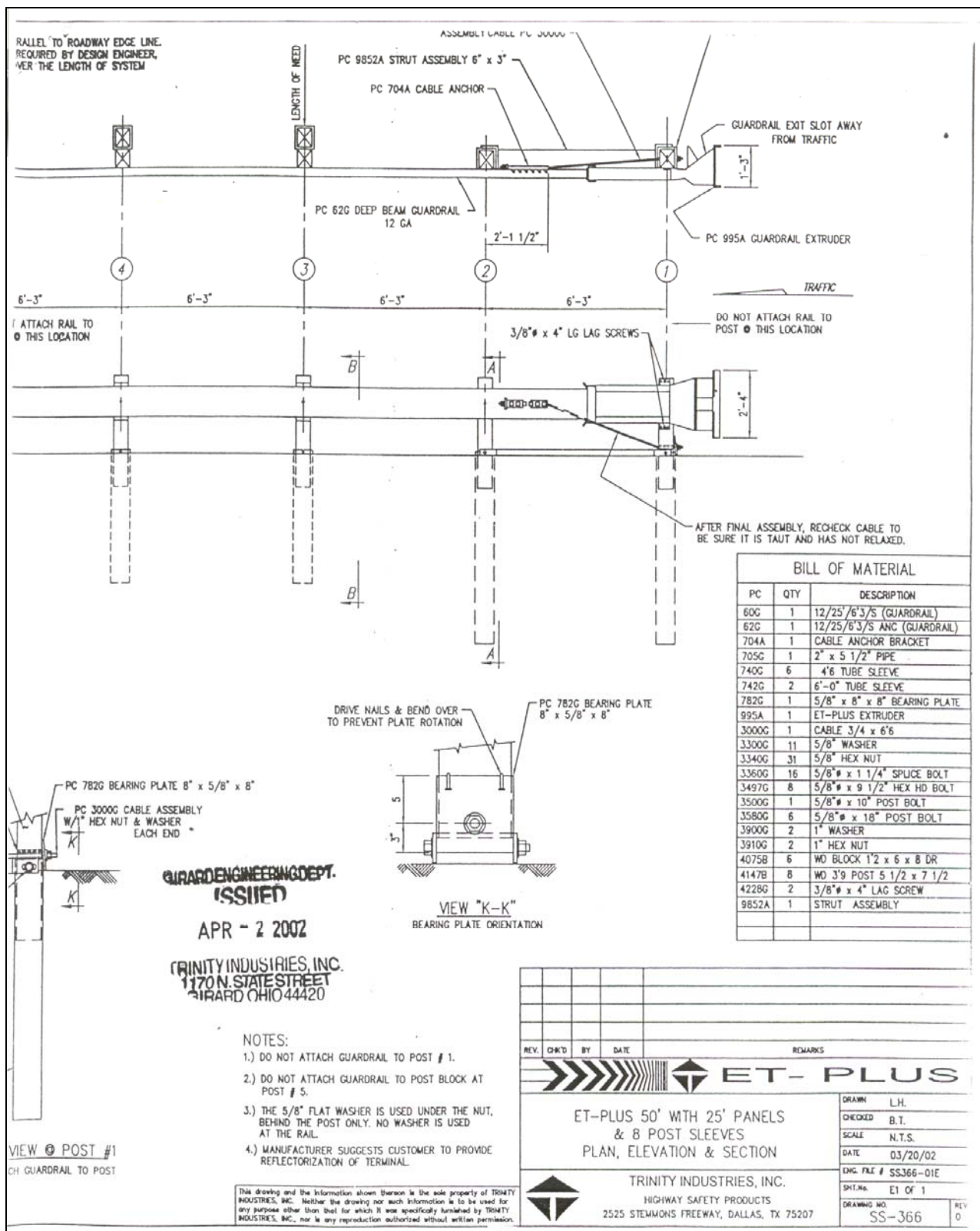
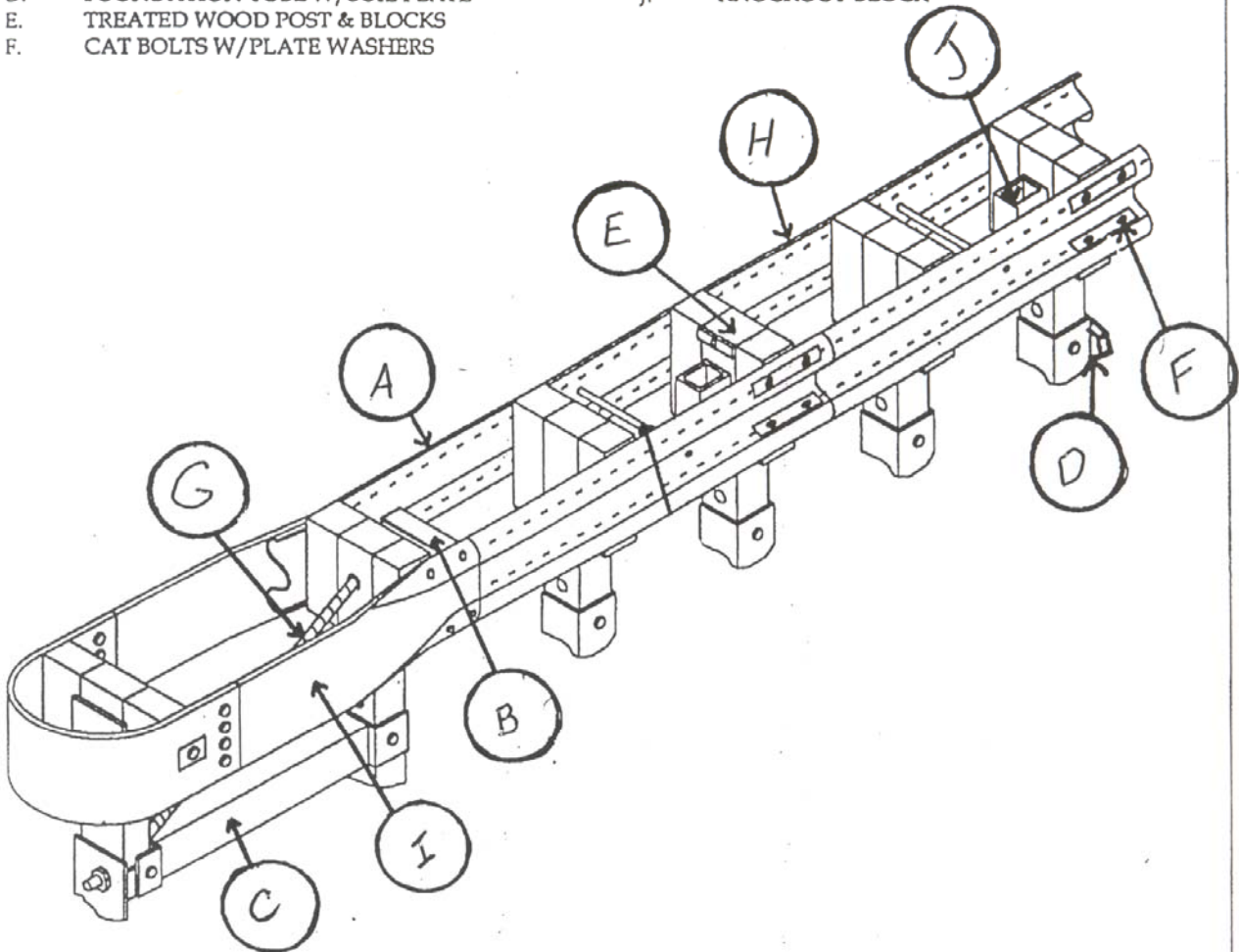


Figure 11-3. ET-PLUS End Treatment

## TRINITY INDUSTRIES, INC.

- A. 12 GA SLOTTED RAIL
- B. SPACER CHANNEL
- C. STRUT CHANNEL
- D. FOUNDATION TUBE W/SOIL PLATE
- E. TREATED WOOD POST & BLOCKS
- F. CAT BOLTS W/PLATE WASHERS

- G. ANCHOR CABLE
- H. 10 GA SLOTTED RAIL
- I. 10 GA NOSE
- J. KNOCKOUT BLOCK



C-A-T

**Figure 11-4. C-A-T End Treatment**

# The G-R-E-A-T® System

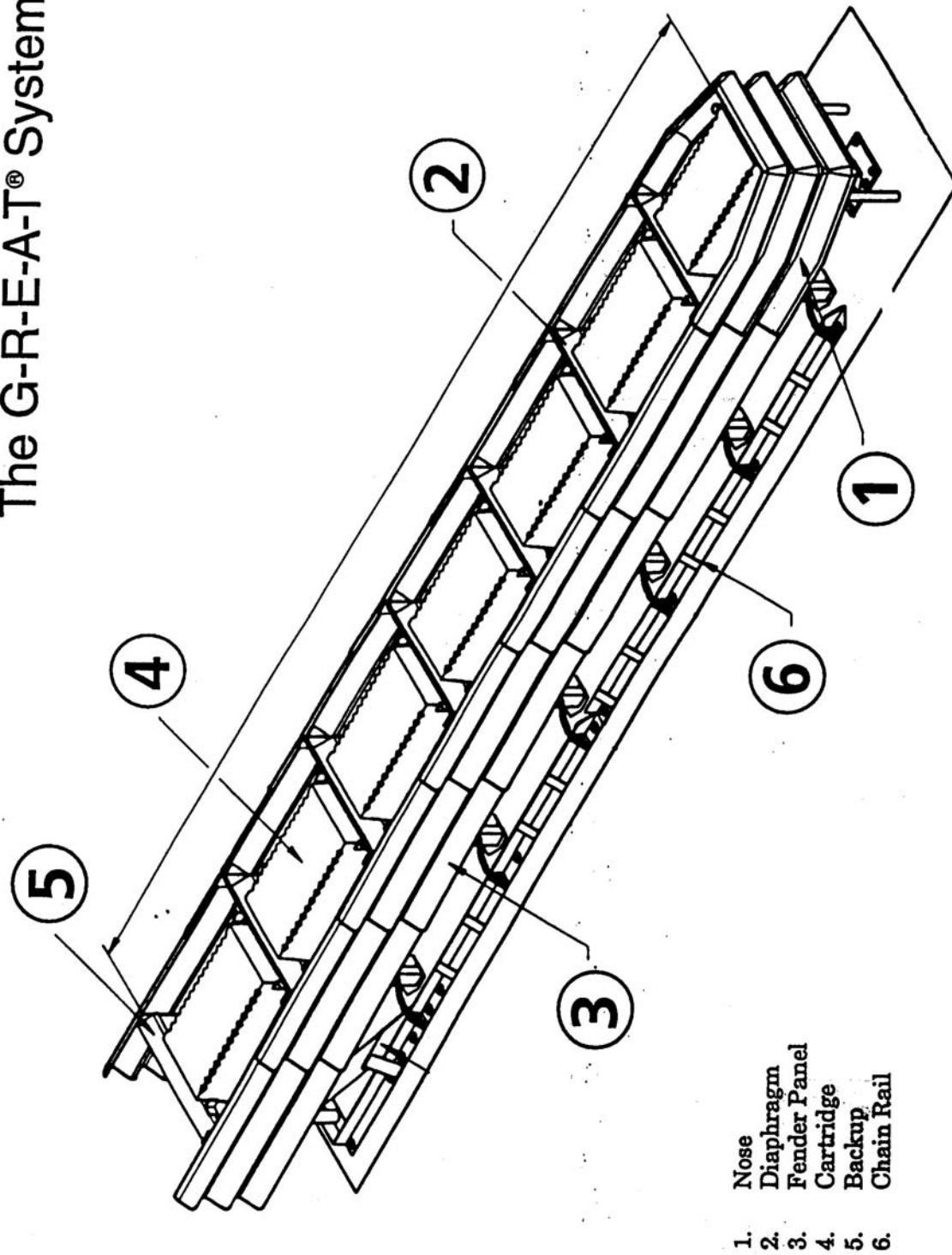


Figure 11-4. Guardrail Energy-Absorbing Terminal (GREAT)

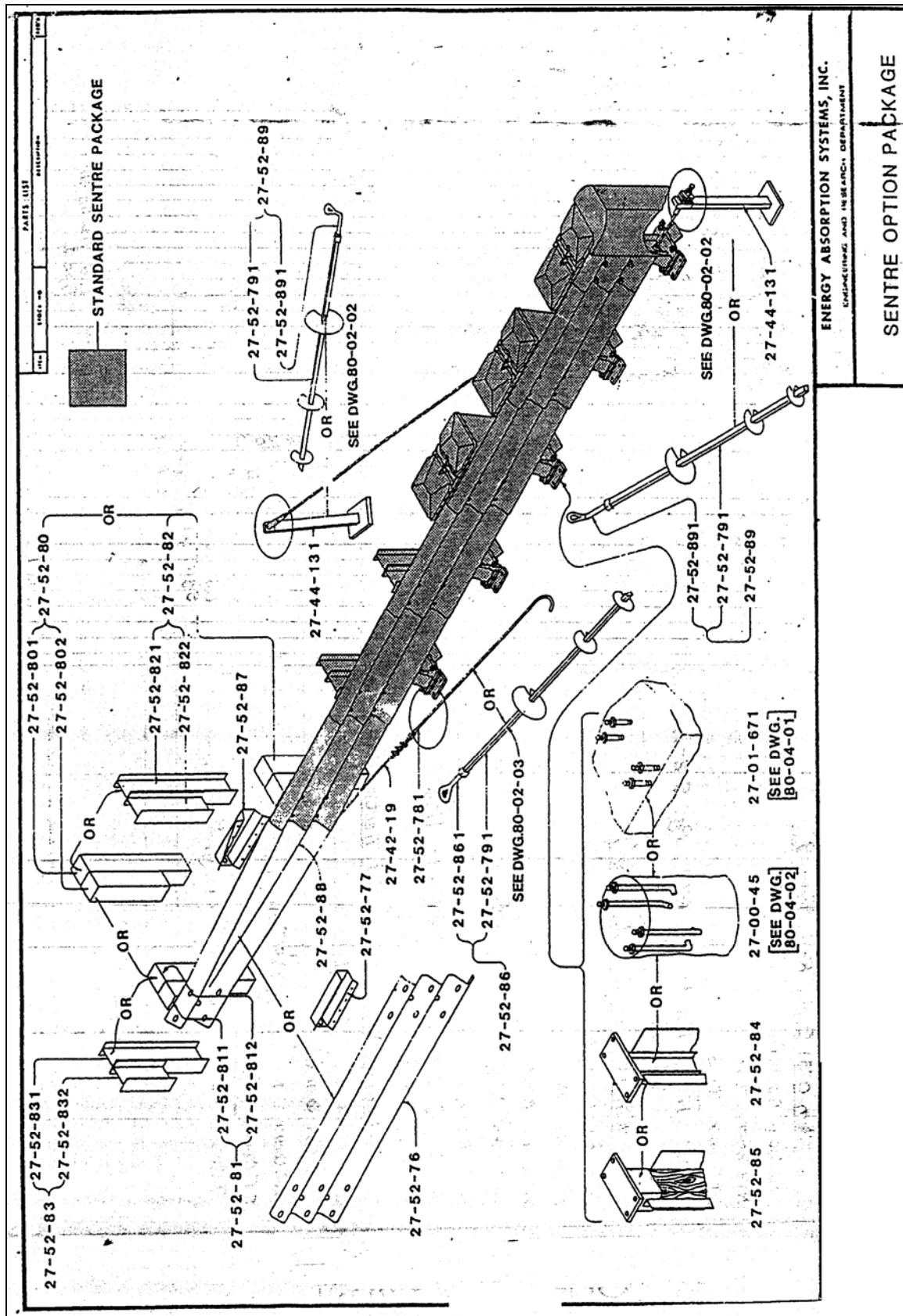


Figure 11-5. Sentre Impact Attenuator